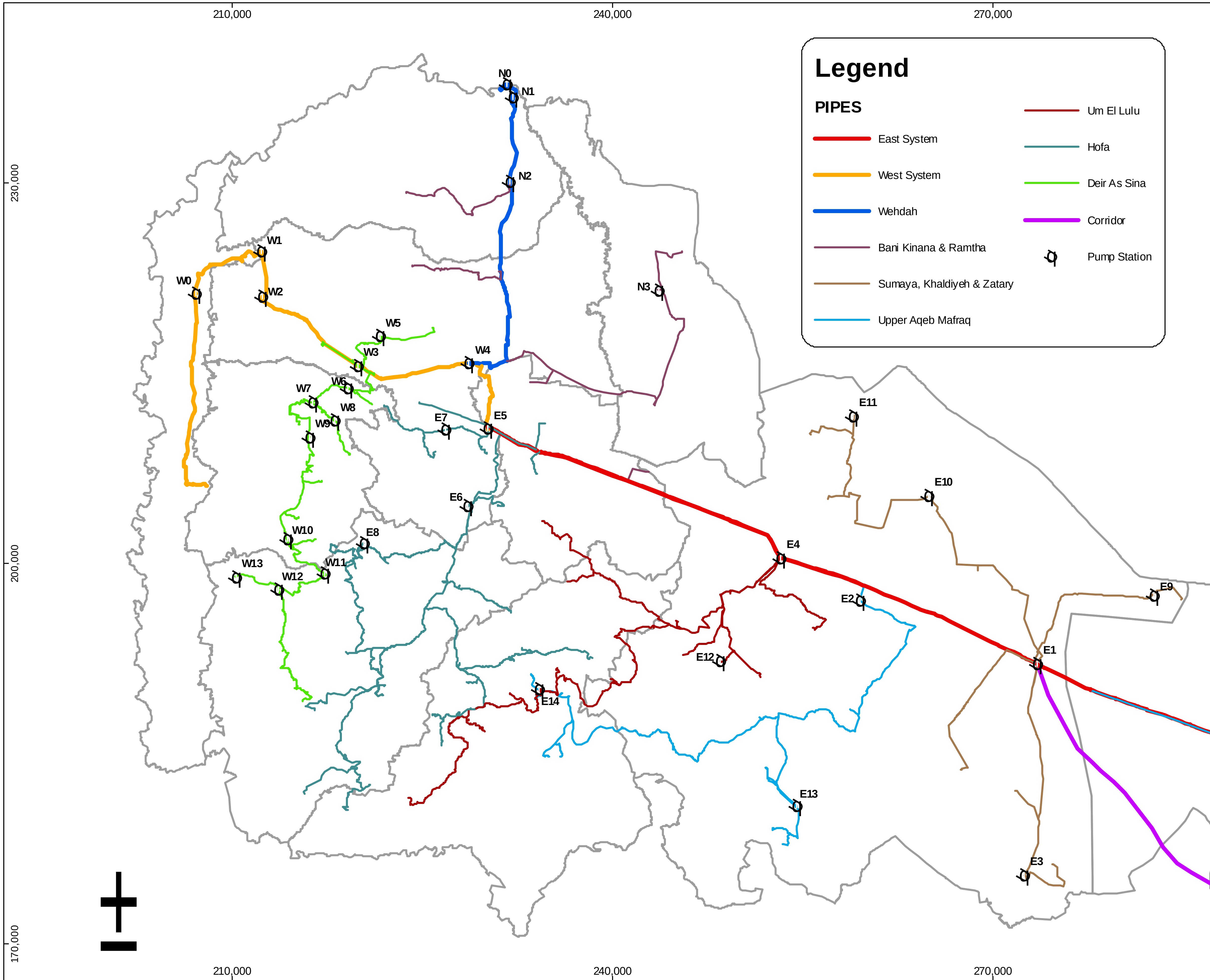


PUMP STATION	
ID	LOCATION
E1	ZATARY
E2	NEW
E3	KHALDIYEH
E4	UM EL LULU
E5	HOFA
E6	SAMAD
E7	JUHFIYYA
E8	AIN AL TANOUR
E9	KOUM AHMAR
E10	SUMAYA
E11	SWAYLIMA
E12	RHAB WELL
E13	ZNIYYA
E14	SHAWAHED
N0	NEW WEHDEH PS0
N1	NEW WEHDEH PS1
N2	NEW WEHDEH PS2
N3	AL MAHASI
W0	WADI AL ARAB PS0
W1	WADI AL ARAB PS1
W2	WADI AL ARAB PS2
W3	WADI AL ARAB PS3
W4	ZUBDAT
W5	NEW
W6	NEW
W7	OYOON AL HAMAM
W8	TUBNEH BOOSTER
W9	NEW
W10	OLD JUDYTA
W11	NEW
W12	ZUQAQ
W13	HALAWA
W14	SHAWAHED

DRAWING SCALE: 1:300,000

THE HASHEMITE KINGDOM OF JORDAN
MINISTRY OF WATER AND IRRIGATION
WATER AUTHORITY

CDM International Inc.

NORTHERN GOVERNORATES WATER TRANSMISSION SYSTEM FEASIBILITY STUDY

Pump Stations in Proposed Projects

PROJECT No.: 3029-42324

FIGURE No.: 8-17

The estimated costs for the ten projects are summarized in **Table 8-1**, comprising the costs of distribution reservoirs, transmission pipelines, pump stations, and water treatment. The total cost of the projects is estimated at $231 million, Costs for rehabilitation of existing facilities, and for a centralized monitoring and control system, have been allocated to the ten projects, as shown in **Table 8-1**. The estimated costs of secondary/tertiary distribution improvements are not included in **Table 8-1**; these costs have been estimated at $108 million under the WLRP.

Table 8-1 Estimated Costs of Proposed Projects ($ million)

Project	Reservoirs	Pipes	Pump Stations	Monitoring & Control	Water Treatment	Rehab of Wells, PSs	Total Cost	% of Cost
Primary Transmission								
East System		22.71	1.50	1.53		2.17	27.91	12.1%
West System		0.00	0.88	0.98	7.80	2.18	11.84	5.1%
Wehdeh System	0.71	18.62	7.96	0.36	22.68		50.33	21.8%
Corridor System		6.47		0.31			6.78	2.9%
Subsystems								
Sumaya Khaldiyeh Zatary	2.84	3.03	0.56	0.93			7.36	3.2%
Upper Aqeb/Mafraq	5.48	25.43	0.38	0.66			31.95	13.9%
Um El Lulu	5.82	12.87	0.28	0.74			19.70	8.5%
Hofa	13.27	20.62	2.30	1.26			37.45	16.2%
Bani Kinana/Ramtha	4.87	7.21	0.62	0.43			13.13	5.7%
Deir As Sina	9.48	11.80	1.75	1.13			24.16	10.5%
Total	42.47	128.76	16.22	8.33	30.48	4.35	230.61	100.0%
Percentage of Cost	18.4%	55.8%	7.0%	3.6%	13.2%	1.9%	100.0%	

Details on the cost estimates of the KAC and Wehdeh water treatment plants, and on the reservoirs, pump stations and pipelines, are presented in **Appendix G** and **Appendix J,** respectively.

8.4 Rehabilitation of Existing Transmission Facilities

Under this study, several investigations have been made on rehabilitation of existing facilities, as detailed in the Appendices to this report. For pump stations and deep wells, the rehabilitation requirements and estimated costs of rehabilitation related to mechanical systems are described in **Appendix A**, and the rehabilitation of electrical equipment and instrumentation at wells and pump stations have been evaluated and the costs estimated in **Appendix B.** Based on the energy-management considerations described in **Appendix F**, it is recommended that variable-frequency drives be considered as part of the rehabilitation and upgrading of facilities at deep wells to reduce energy consumption.

As itemized in these Appendices, the total cost for rehabilitation is estimated at $4.4 million, of which $2.0 million is for rehabilitation of mechanical systems, and $2.4 million is for rehabilitation of electrical systems. The estimates of the rehabilitation works are based on local costs of similar works assuming that these works would be implemented by a local contractor

8.5 Centralized Monitoring and Control System

The conceptual design of a centralized monitoring and control system is presented in **Appendix H**. The SCADA system can be initiated and expanded in a modular fashion, with the costs dependent upon the number of operations control centers and the number and types of facilities to be monitored and controlled. The types of facilities include wells, pump stations, reservoirs, treatment plants, bulk flow meters, and isolation valves. The investment in the centralized monitoring and control system will be phased to match development and expansion of the NGWA transmission and distribution systems.

8.6 Proposed Sequence in Project Development

The resulting sequence of the proposed projects is shown on **Figure 8-18**. The completion years for the four water sources to be developed range from 2006 to 2018, and for each of these sources there is a corresponding project for improvements to the primary transmission system. The subsystems of local distribution reservoirs, and associated pump stations and pipelines, can be undertaken at the same time as the primary transmission projects, but cannot be placed into operation until the primary transmission projects are completed. The East transmission system contains four subsystems, which can be undertaken independently from each other, and in any sequence. However, on the basis of urgent need, the Um El Lulu subsystem that will serve Jerash is considered to have the highest priority.

The proposed implementation schedule for the project, showing the time allocations for design, bid documents, bidding and award, and construction, are shown on **Figure 8-19**. The estimated costs by project and year are shown on **Figure 8-20**.

Figure 8-18 Proposed Sequence in Project Development

YEAR COMPLETED:	2006	2007	2009	2012	2015	2018
SOURCE DEVELOPED:	King Abdullah Canal 500 m3/hour	Aqeb-Zatary Wells 11.7 MCM	Wehdeh Dam 30 MCM	None	None	Corridor Wells 10 MCM
PRIMARY TRANSMISSION PROJECTS:	West System	East System	Wehdeh System	None	None	Corridor System
TRANSMISSION & DISTRIBUTION SUBSYSTEM PROJECTS:	None	Um El Lulu	Bani Kinana Ramtha UA/Mafraq	Hofa	Deir As Sina Sumaya Khaldiya	None
MONITORING & CONTROL SYSTEM PROJECTS:	Existing System	East System	West System	Three Subsystems	Three Subsystems	Corridor System
REHABILITATION PROJECTS:	Existing System	Existing System	N/A	N/A	N/A	N/A

Figure 8-19 Proposed Implementation Schedule

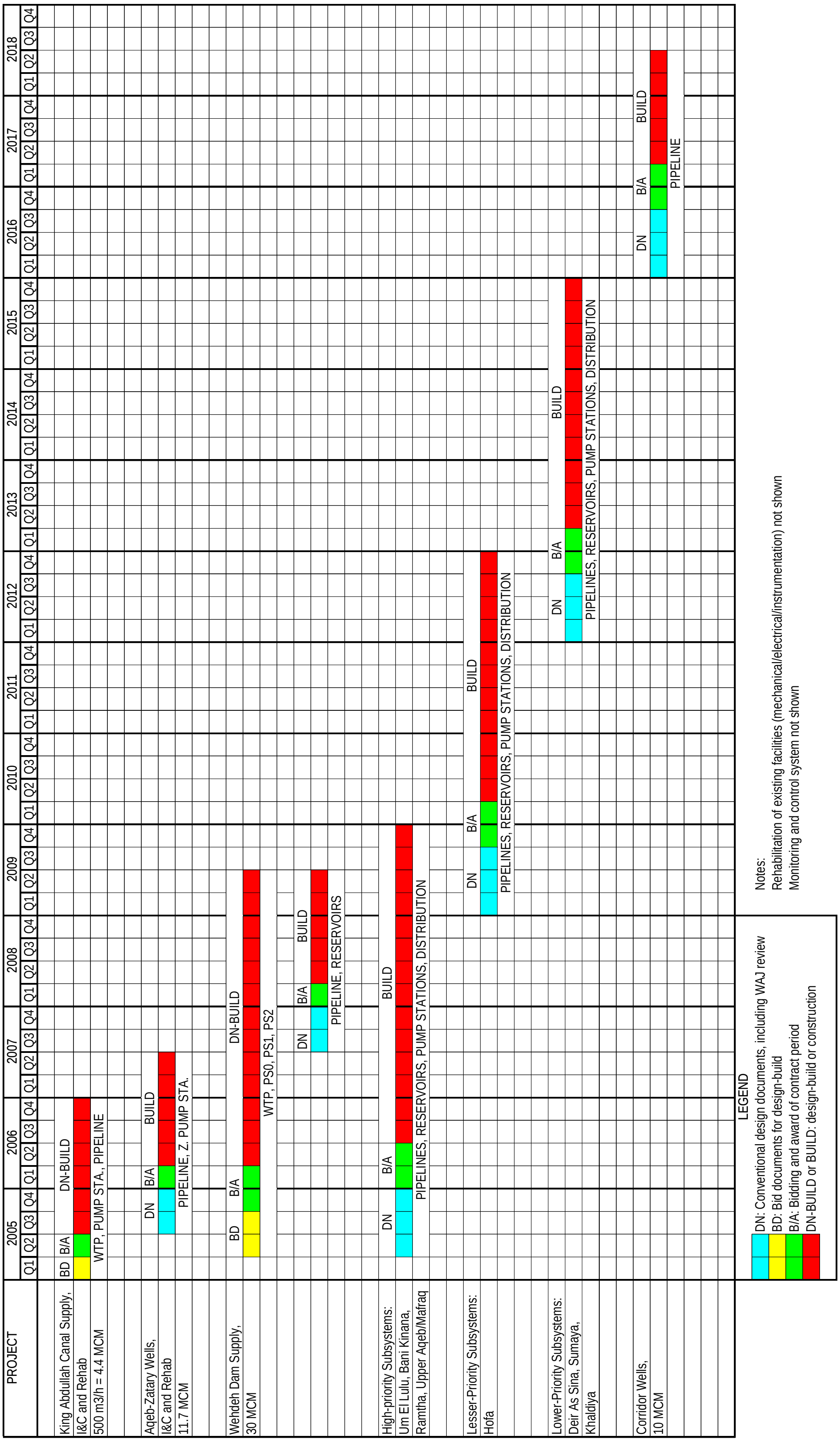
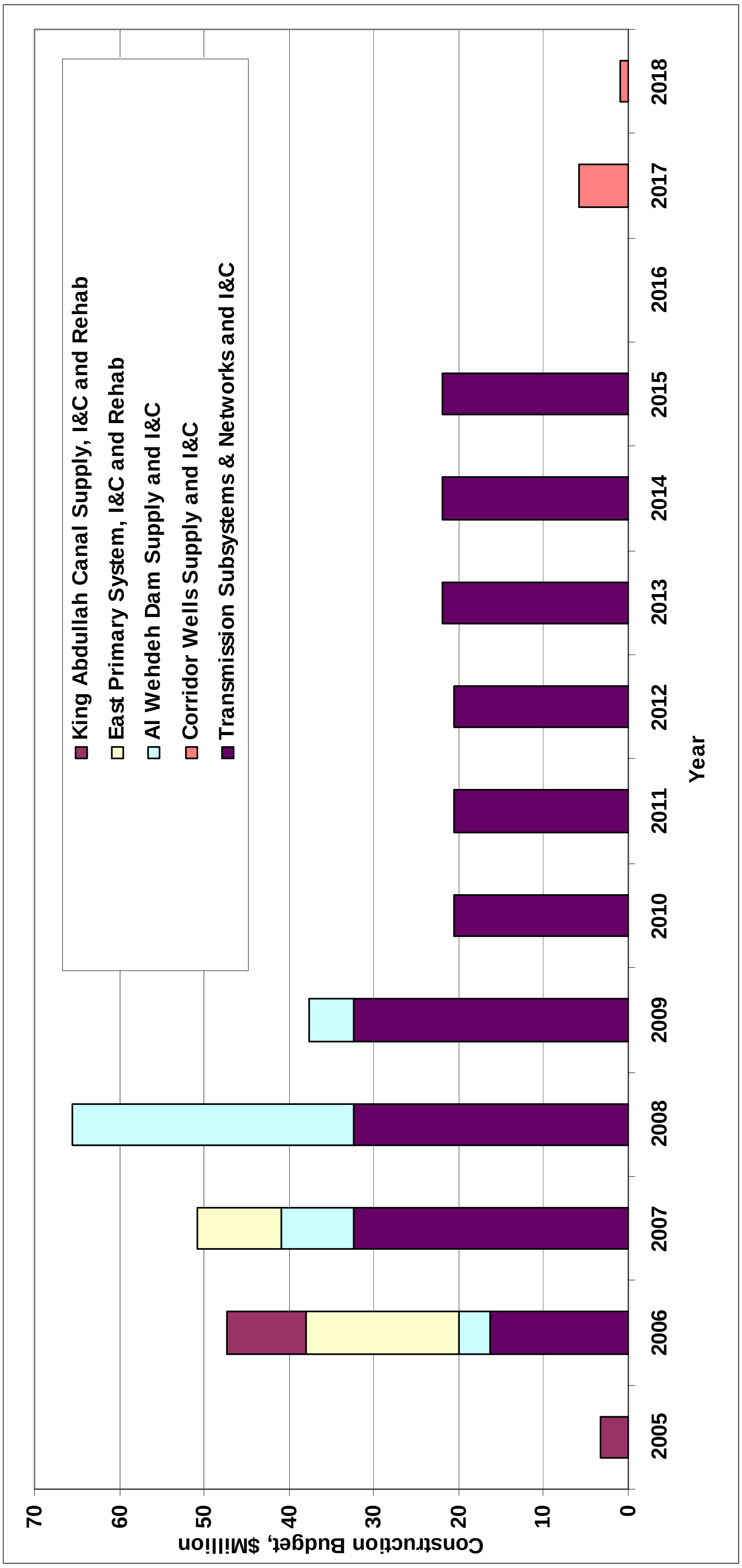


Figure 8-20 Construction Costs by Project / Year



8.7 Financial Analysis

A financial analysis has been carried out to examine the financial impacts of implementing the proposed projects. A variety of assumptions and financing options have been examined by developing a financial spreadsheet model that incorporates the water demand forecasts, the estimates of O&M (Operation and Maintenance) costs and capital investment costs, the revenues, and the grants or loans that may be used to finance the project. The detailed description of the financial data and assumptions, and the detailed results, are presented in **Appendix L**. The results are summarized below.

A basic difficulty faced in financial analysis of a regional water authority in Jordan, such as NGWA, is that a system of uniform nation-wide water tariffs applies to all water customers. The government of Jordan subsidizes the cost of water to customers, and a system of accounting transfers are used to reflect the import and export of water between regions, without actual cash transfers being made to the regional water authorities. Determining the financing needs of all water projects in Jordan to year 2030 is well beyond the scope of investigation for this feasibility study. Instead, the purpose of the financial analysis is to point out the major financial problems that NGWA and WAJ may face in implementation of the project.

Various annual costs and revenues to year 2030 are shown in **Figure 8-21**, and various unit prices of water (in JD/m3) are shown in **Figure 8-22**, based on the results obtained in **Appendix L**. The major conclusions from the financial analysis include the following:

- Revenues of NGWA are very limited compared to the costs as forecast over the planning period. Typically, NGWA obtains only 0.30 JD/m3 for metered water use, using the uniform nation-wide tariffs. These national-wide tariffs are too low, and less than 30% of the billed revenue is collected. Even if 85% of the billed revenue were collected, it would be insufficient to pay the O&M cost (both under a "base case" and under a "case of improved efficiency of O&M"). The tariffs would have to be twice as great (about 0.60 JD/m3) to cover the existing levels of O&M cost (assuming no efficiency improvements).
- If NGWA were to borrow money at commercial rates and make annual repayments on commercial loans, water tariffs would have to be as much 1.05 JD/m3 which is 3.5 times higher than the existing tariff levels.
- Capital financing by a mixture of 70% grants and 30% soft loans, coupled with more efficient O&M, would reduce the required average tariff to about 0.50 JD/m3, which is considered more realistic and affordable to users.

Figure 8-21 Financial Costs and Revenues over the Planning Period

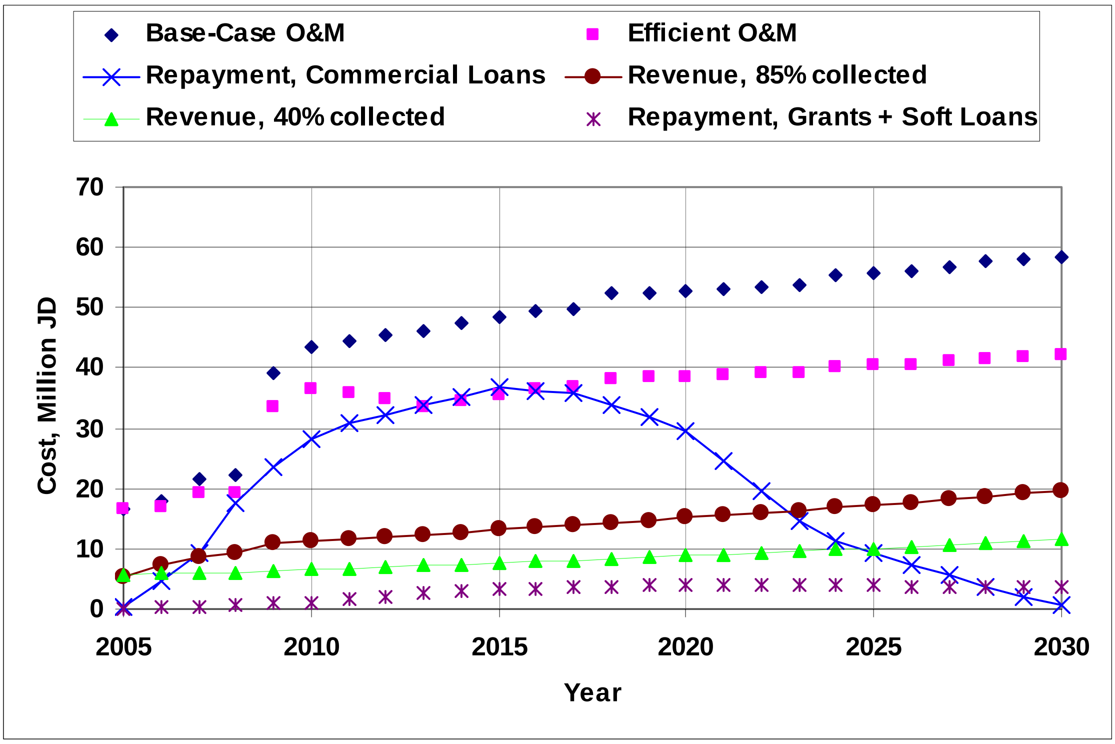


Figure 8-22 Unit Costs and Tariff Levels over the Planning Period